REMARKS

Claims 1-5, 7, 9, 11, 13, 15 and 17 were rejected under 35 U.S.C. §102(b) as being anticipated by Kawai et al. (JP 08029202). Claims 14, 16, 18 and 19 were rejected under 35 U.S.C. §103(a) as being unpatentable over Yamada (US 6,351,657) in view of Kawai et al. (JP 08029202). Claim 6 was rejected under 35 U.S.C. §103(a) as being unpatentable over Kawai et al. (JP 08029202) in view of Extance (EP 0210825). The examiner is requested to reconsider these rejections.

Enclosed is an English language translation of Kawai et al. This translation is a machine translation from the Japanese Patent Office web site.

Claim 1 has been amended above to clarify applicants' claimed invention. In particular, claim 1 claims that the rotatable member comprises an element providing multiple sets of electromagnetic radiation transmissions, each set comprising a plurality of areas having respectively different electromagnetic radiation transmission characteristics, and that the sets form multiple repetitive sequences about the element. Kawai et al. discloses an optical disk with parts 21, 22, and 23 which have three different reflection factor levels of a reflection film. However, Kawai et al. does not disclose or suggest that the optical disk has multiple sets of electromagnetic radiation transmissions, each set comprising a plurality of areas having respectively different electromagnetic radiation transmission characteristics, and that the sets form multiple repetitive sequences about the element as claimed in claim 1. Fu et al. (US 5,748,181)

PAGE 7/17 * RCVD AT 4/14/2006 9:59:13 AM [Eastern Daylight Time] * SVR:USPTO-EFXRF-1/0 * DNIS:2738300 * CSID:2039440245 * DURATION (mm-ss):05-24

discloses sets of holes 23111-23113. However, Fu et al. merely discloses holes; not surfaces as claimed in claim 1. There appears to be no suggestion in Kawai et al. and Fu et al. to combine the sets of holes of Fu et al. with the reflective surfaces 21-23 of Kawai et al. Therefore, claim 1 is also not obvious in view of Kawai et al. and Fu et al. Extance (EP 0210825) discloses different colored elements 13. However, Extance et al. only discloses changing wavelength; not changing the amount of energy passing through or reflected from the elements 13. Thus, there appears to be no suggestion to combine Extance et al. with Kawai et al. The suggestion only comes after reading applicants' patent application. The features of claim 1 are not disclosed or suggested in the art of record. Therefore, claim 1 is patentable and should be allowed.

Claim 3 has been amended above to clarify applicants' claimed invention. Claim 3 claims that the element provides multiple sets of electromagnetic radiation transmissions, each set comprising a plurality of areas having respectively different electromagnetic radiation transmission characteristics, and that the sets form multiple repetitive sequences about the element. Kawai et al. discloses an optical disk with parts 21, 22, and 23 which have three different reflection factor levels of a reflection film. However, Kawai et al. does not disclose or suggest that the optical disk has multiple sets of electromagnetic radiation transmissions, each set comprising a plurality of areas having respectively different electromagnetic radiation transmission characteristics, and that the sets form multiple repetitive sequences about the

PAGE 8/17 * RCVD AT 4/14/2006 9:59:13 AM [Eastern Daylight Time] * SVR:USPTO-EFXRF-1/0 * DNIS:2738300 * CSID:2039440245 * DURATION (mm-ss):05-24

element as claimed in claim 3. Fu et al. (US 5,748,181) discloses sets of holes 23111-23113. However, Fu et al. merely discloses holes. There appears to be no suggestion in Kawai et al. and Fu et al. to combine the sets of holes of Fu et al. with the reflective surfaces 21-23 of Kawai et al. Therefore, claim 3 is also not obvious in view of Kawai et al. and Fu et al. Extance discloses different colored elements 13. However, Extance et al. only discloses changing wavelength; not the amount of energy transmitted or reflected by the elements 13. The features of claim 3 are not disclosed or suggested in the art of record. Therefore, claim 3 is patentable and should be allowed.

Claim 4 has been amended to clarify applicants claimed invention. Claim 4 claims that the element provides multiple sets of electromagnetic radiation transmissions, each set comprising a plurality of areas having respectively different electromagnetic radiation transmission characteristics, and the sets forming multiple repetitive sequences about the element. Kawai et al. discloses an optical disk with parts 21, 22, and 23 which have three different reflection factor levels of a reflection film. However, Kawai et al. does not disclose or suggest that the optical disk has multiple sets of electromagnetic radiation transmissions, each set comprising a plurality of areas having respectively different electromagnetic radiation transmission characteristics, and the sets forming multiple repetitive sequences about the element as claimed in claim 4. Fu et al. (US 5,748,181) discloses sets of holes 23111-23113. However, Fu et al. merely discloses holes. There appears to be no suggestion in

PAGE 9/17 * RCVD AT 4/14/2006 9:59:13 AM [Eastern Daylight Time] * SVR:USPTO-EFXRF-1/0 * DNIS:2738300 * CSID:2039440245 * DURATION (mm-ss):05-24

Kawai et al. and Fu et al. to combine the sets of holes of Fu et al. with the reflective surfaces 21-23 of Kawai et al. Therefore, claim 4 is also not obvious in view of Kawai et al. and Fu et al. Extance discloses different colored elements 13. However, Extance et al. only discloses changing wavelength; not the amount of energy. The features of claim 4 are not disclosed or suggested in the art of record. Therefore, claim 4 is patentable and should be allowed.

Claim 15 has been amended above to clarify applicants' claimed invention. In particular, claim 15 claims that the element comprises multiple sets of electromagnetic radiation transmissions, each set comprising a plurality of areas having respectively different electromagnetic radiation reflection characteristics, and that the sets form multiple repetitive sequences about the element. As noted above, Kawai et al. discloses an optical disk with parts 21, 22, and 23 which have three different reflection factor levels of a reflection film. However, Kawai et al. does not disclose or suggest that the optical disk has multiple sets of electromagnetic radiation transmissions, each set comprising a plurality of areas having respectively different electromagnetic radiation reflection characteristics, and that the sets form multiple repetitive sequences about the element as claimed in claim 15. Fu et al. (US 5,748,181) discloses sets of holes 23111-23113. However, Fu et al. merely discloses holes; not areas with different reflection characteristics as claimed in claim 15. There appears to be no suggestion in Kawai et al. and Fu et al. to combine the sets of holes of Fu et al. with the reflective surfaces 21-23 of Kawai et al. Therefore, claim 15 is also

PAGE 10/17 * RCVD AT 4/14/2006 9:59:13 AM [Eastern Daylight Time] * SVR:USPTO-EFXRF-1/0 * DNIS:2738300 * CSID:2039440245 * DURATION (mm-ss):05-24

not obvious in view of Kawai et al. and Fu et al. Extance discloses different colored elements 13. However, Extance et al. only discloses changing wavelength; not the amount of energy. The features of claim 15 are not disclosed or suggested in the art of record. Therefore, claim 15 is patentable and should be allowed.

Claim 17 has been amended above to clarify applicants' claimed invention. In particular, claim 17 claims that the rotatable member comprises multiple sets of electromagnetic radiation transmissions, each set comprising a plurality of electromagnetic radiation affecting surfaces having respectively different electromagnetic radiation affecting characteristics, and that the sets form multiple repetitive sequences about the element. As noted above, Kawai et al. discloses an optical disk with parts 21, 22, and 23 which have three different reflection factor levels of a reflection film. However, Kawai et al. does not disclose or suggest that the optical disk has multiple sets of electromagnetic radiation transmissions, each set comprising a plurality of electromagnetic radiation affecting surfaces having respectively different electromagnetic radiation affecting characteristics, and that the sets form multiple repetitive sequences about the element as claimed in claim 17. Fu et al. (US 5,748,181) discloses sets of holes 23111-23113. However, Fu et al. merely discloses holes; not surfaces as claimed in claim 17. There appears to be no suggestion in Kawai et al. and Fu et al. to combine the sets of holes of Fu et al. with the reflective surfaces 21-23 of Kawai et al. Therefore, claim 17 is also not obvious in view of Kawai et al. and Fu et

PAGE 11/17 * RCVD AT 4/14/2006 9:59:13 AM [Eastern Daylight Time] * SVR:USPTO-EFXRF-1/0 * DNIS:2738300 * CSID:2039440245 * DURATION (mm-ss):05-24

al. Extance discloses different colored elements 13. However, Extance et al. only discloses changing wavelength; not the amount of energy. The features of claim 17 are not disclosed or suggested in the art of record. Therefore, claim 17 is patentable and should be allowed.

Though the dependent claims contain their own allowable subject matter, these claims should at least be allowable due to their dependence from allowable independent claims. However, to expedite prosecution at this time, no further comment will be made except for the following. Yamada discloses electrodes 10. There is no disclosure or suggestion in the cited art of replacing Yamada's electrodes 10 with the reflective surfaces 21-23 of Kawai et al. The suggestion only comes after reading applicants' patent application.

For all of the foregoing reasons, it is respectfully submitted that all of the claims now present in the application are clearly novel and patentable over the prior art of record. Accordingly, favorable reconsideration and allowance is respectfully requested. Should any unresolved issue remain, the examiner is invited to call applicants' attorney at the telephone number indicated below.

PAGE 12/17 * RCVD AT 4/14/2006 9:59:13 AM [Eastern Daylight Time] * SVR:USPTO-EFXRF-1/0 * DNIS:2738300 * CSID:2039440245 * DURATION (mm-ss):05-24

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Respectfully submitted,

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PAGE 13/17 * RCVD AT 4/14/2006 9:59:13 AM [Eastern Daylight Time] * SVR:USPTO-EFXRF-1/0 * DNIS:2738300 * CSID:2039440245 * DURATION (mm-ss):05-24

* NOTICES *

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damages caused by the use of this translation.

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the rotary encoder constituted with the light source, an optical head, and an optical disk in more detail about a rotary encoder.
[0002]
[Description of the Prior Art] In recent years, small and a high resolution rotary encoder have been required in FA fields, such as a robot and an NC machine tool. Conventionally, as a rotary encoder of the type of a high resolution, as shown in JP,61-100611,A, there is an optical thing with a slit pattern disk. This slit is minced by the optical disk as a graduation showing angle of rotation, in order to acquire the location detection information on a high resolution. The light which emitted light from the light-emitting part penetrates this disk, and reads the light which passed along the slit of a disk by the light sensing portion.
[0003] A limitation is in the magnitude of a slit detectable in it being this method, and there is difficulty in moreover making it a miniaturization by the high resolution. Then, these people applied for the rotary encoder of the method using an optical head and an optical disk as Japanese Patent Application No. No. 111537 [five to]. While according to this invention improving the trouble in the above-mentioned conventional technique and miniaturizing a rotary encoder, when attaching a rotary encoder by repair etc., the rotary encoder which can make easy justification of the zero of a slit pattern disk and the machine section can be obtained.
[0004]
[Problem(s) to be Solved by the Invention] However, since there is no function of energy-saving actuation to reduce the consumption of energy when a main power supply is shut off for invention of this point **, there is a problem said that the time amount which can back up with a dc-battery becomes short. That is, even when a main power supply is shut off, the robot and NC machine tool in which the rotary encoder was attached may be turned by hand etc. At this time, a rotary encoder must perform location detection by backup of a dc-battery. And since each of each above-mentioned Prior arts does not have the function of energy-saving actuation, also during backup, the same big electric energy as the case where the main power supply is valid is consumed, and the time amount which can back up with a dc-battery becomes short.
[0005] This invention aims at offering the rotary encoder which can perform energy-saving actuation which lessened energy expenditure.
[0006]
[Means for Solving the Problem] The driving means which this invention makes rotate an optical disk and this optical disk in order to attain the above-mentioned purpose, It is reflected by said optical disk from the Mitsuteru gunner stage which irradiates light energy, and said disk. Or connect with a light-receiving means to receive said transmitted light energy, and said light-receiving means, and it sets to the rotary encoder which consisted of operation means which carry out data processing of the information acquired from said received light energy. On said optical disk, the annular pattern which

changes over a three-stage at least is prepared so that it may continue decreasing among 1 round, or a reflection factor or transmission continues increasing among 1 round of an optical disk.
[0007]
[Function] A rotary encoder changes an exposure means to pulse irradiation at the time of energy-saving actuation. An operation means reads the annular pattern which changes over said three-stage. If an optical disk rotates one time, change between the greatest reflection factor or permeability, the minimum reflection factor, or permeability will occur. A rotary encoder detects this change and judges with the optical disk having rotated one time. Moreover, the hand of cut of an optical disk is judged by distinguishing having changed from max to min, and having changed from min to max.
[0008]
[Example] Below, it explains at a detail, referring to a drawing about the example using a reflective type optical disk for the rotary encoder of this invention.
[0009] (Example 1) Drawing 2 is the perspective view showing the configuration of one example of a rotary encoder 1, and drawing 3 is a sectional view. Among drawing, two are an optical disk and the basic intelligence which gives own angle of rotation of an optical disk, a hand of cut, and the information about a rotational frequency is recorded. 3 is the driving means of the motor made to rotate an optical disk 2.
[0010] 4 is an optical head and includes the Mitsuteru gunner stage which irradiates light energy on the front face of an optical disk 2, and a light-receiving means to receive said light energy reflected from the optical disk 2. 5 is an operation means, and it connects with the light-receiving head 4, and it carries out data processing of angle of rotation of the optical disk 2 removed from the light energy which received light, a hand of cut, and the information about a rotational frequency. The circuit of the operation means 5 and others is mounted in the circuit board 6.
[0011] One example of the configuration of the optical head 4 used in this invention is shown in drawing 4 . The light energy emitted from the Mitsuteru gunner stage 30 condenses in predetermined size according to the condensing optical system 50, and is made to irradiate optical disk 2 front face. The condensing optical system 50 receives the light energy from the Mitsuteru gunner stage 30 which consists of semiconductor laser etc. The collimate lens 51 for forming a collimation beam with a predetermined path, and the polarization beam splitter 52 which has a well-known configuration, The condensing optical system 50 which consists of objective lenses 54 which irradiate the position of a disk 2, and starts further lambda/4 plate 53 which has quarter-wave length, and said collimation beam The light energy reflected from the optical disk 2 is separated by the collimation beam and polarization beam splitter 52 by which incidence is carried out, and it consists of prism 55 by which incidence is carried out to the light-receiving means 40 which consists of photo diodes etc. and which was formed like. The objective lens 54 has the actuator 56.
[0012] The circuit diagram of the rotary encoder of this example is shown in drawing 1 . In drawing, the exposure means 30, the light-receiving means 40, the condensing optical system 50, and an actuator 11 are formed in the optical head 4. Moreover, the drive control circuit 12 for driving the actuator 11 of the optical head 4 other than the operation means 5 and the Mitsuteru gunner stage 30 are established in continuous irradiation, or the continuation / pulse irradiation power source 13 for carrying out pulse irradiation by the circuit board 6.
[0013] Moreover, the power-source change-over circuit 16 which switches the dc-battery 15 for backup of the optical head 4, the main power supply 14 prepared into the robot as a power source over each circuit on the circuit board 6, and a rotary encoder 1 is formed. Moreover, from this power switching circuitry 16, the signal of having changed the power source is also supplied to operation means 5 grade. One example of the configuration of an optical disk 2 is shown in drawing 5 - drawing 7 .
[0014] As shown in drawing 5 , as for the optical disk 2 of this example, the 1st truck 7, the 2nd truck group 8, and the 3rd truck 9 are established in annular from an outside, respectively. The 1st truck 7 is a pattern for detecting angle of rotation and a hand of cut, the 2nd truck 8 is two or more concentric circular absolute-address signal trains, and the 3rd truck 9 is a truck for detecting the hand of cut and rotational frequency at the time of energy-saving actuation. What expanded some each truck A is shown

in drawing 6 .
[0015] Since the 1st truck 7 is indicated by above-mentioned Japanese Patent Application No. No. 111537 [five to] at the detail, it is stopped to easy explanation here. Three pits 71 of the same die length are arranged in the hoop direction of an optical disk 2 by making the specific location of an optical disk 2 into a criteria location. Then, the pits 72, 73, and 74 which differ in three kinds of die length mutually are prepared, the reiterative sequence of three kinds of starting pits 72, 73, and 74 is regularly carried out to this order, and an annular pattern is formed.
[0016] The configuration, a dimension, a reflection factor, etc. change at least any they are, and make the field where reflection factors differ, as for these pits, form mutually, respectively. The 2nd truck group 8 is what recorded the signal on include-angle reading absolutely, for example, 14 concentric circular truck groups are prepared, in each truck, each annular part (i.e., 360 degrees) is divided into 8192, and the pit for an include-angle count where the signal is absolutely recorded on include-angle reading is prepared.
[0017] The 3rd truck 9 is a truck for detecting the hand of cut and rotational frequency at the time of energy-saving actuation. About this 3rd truck 9, that perimeter is shown in drawing 7 . An annular pattern is formed from the parts 21, 22, and 23 which have three different reflection factor level (include angle of 120 degrees) stair-like. Such a pattern vapor-deposits metallic reflection film, such as Cr, aluminum, and Au, on a disc-like glass substrate or a plastic plate, and can etch and manufacture a pattern with a FOTORISO graphic method. Moreover, patterns, such as vacuum evaporationo and a slit with width of face smaller than the diameter of a laser beam, can be printed for a metal which is different for making this reflection factor stair-like.
[0018] In addition, in the following explanation, the part 21 with the lowest reflection factor is explained among three reflection factors by calling reflection factor level 1 and the middle part 22 the reflection factor level 2, and calling the part 23 with the highest reflection factor the reflection factor level 3. At the time of the non-actuation of a rotary encoder 1, the optical head 4 is put on the location of the 3rd truck 9. If a rotary encoder 1 starts, a collimation beam will be moved to the outside of the direction of a path of an optical disk 2 with the actuator 11 of the optical head 4. In the meantime, the signal of 14 trucks of the 2nd truck group 8 is read, and an include angle is judged absolutely. Then, in the location of the 1st truck 7, the optical head 4 reads the detecting signal which changes with rotation of an optical disk 2, and detects angle of rotation of an optical disk 2, and a hand of cut.
[0019] Next, if a main power supply 14 is shut off, power switching circuitry 16 will output the signal showing having supplied and changed power from the dc-battery 15 side to the rotary encoder 1. The optical head 4 is moved to the location of the 3rd truck 9 by control of the drive control circuit 12. The operating procedure which detects the engine speed and hand of cut of an optical disk 2 at the time of this backup is explained referring to the flow chart of drawing 8 .
[0020] The flow of drawing 8 is started at the time of a main power supply OFF, and the laser beam irradiated from the optical head 4 is switched from continuous irradiation (step S1)., intermittent exposure, i.e., pulse irradiation Subsequently, the beam spot moves to the 3rd truck 9 from the 1st truck 7 by migration of the optical head 4 (step S2). The beam spot condensed from the optical head 4 is irradiated, and the reflected light which had three different reflection factors in the 3rd truck 9 is detected by the light-receiving means 40 (step S3), and is led to the operation means 5.
[0021] With the operation means 5, by measuring the reflected light reinforcement from a truck with three different reflection factors, a hand of cut is judged (step S4), when reflection factor level is repeated by 1, 2, 3, 1, 2, 3, and increment, it is judged as right-handed rotation, and when conversely repeated by 3, 2, 1, 3, 2, 1, and reduction, it is judged as left-handed rotation. Next, the comparison of a reflection factor 1 and a reflection factor 3 is performed (step S5). While an optical disk 2 goes around, the change of a reflection factor arises. That is, change between the highest reflection factor 3 and the lowest reflection factor 1 arises. Here, when it judges with having rotated one time in the counterclockwise direction when it changed to reflection factors 1-3, -1 is counted (step S6) and it changes to reflection factors 3-1, it judges with having rotated one time in the clockwise direction, and +1 is counted (step S7). After that, repetitive continuation of return and the same processing is carried

out to step S3.

[0022] As explained above, at the time of energy-saving actuation, a rotary encoder 1 performs detection of only a rotational frequency and a hand of cut. Here, the reason for the ability to perform energy-saving actuation is explained. The 3rd truck 9 of the optical disk 2 of this example changes a three-stage reflection factor by one rotation. Therefore, the pulse period of the Mitsuteru gunner stage 30 is selected so that light may be emitted 3 times to one rotation at the time of the maximum rotation of an optical disk 2. for example, the rotational frequency of an optical disk 2 -- maximum-engine-speed 4000rpm it is -- a case -- Mitsuteru -- a gunner -- a stage -- 30 -- five -- ms -- one -- a time -- switching on the light -- ****ing -- ******** -- since -- pulse width -- 0.3 -- microsecond -- the operating current -- 50 -- mA -- laser -- using it -- if -- an average -- the consumed electric current of 3microA -- becoming . That is, energy expenditure can be sharply reduced to the 50mA consumed electric current being required in it being continuous oscillation like the conventional technique. Thus, compared with the case where continuous irradiation is carried out like [at the time of normal operation], there is the large energy-saving effectiveness by changing the pattern of this truck and irradiating pulsed light at this pattern.

[0023] [Example 2] The 2nd example of the invention in this application is explained using drawing 9 . The parts among which the flow chart of drawing 9 counts a rotational frequency in said example 1 differ. Step S1 of drawing 9 to 3 is the same as that of the flow chart of drawing 8 of said example 1. In drawing 9 , the count of a hand of cut and a rotational frequency is performed at one step (step S11). If reflection factor level changes to 1 from 3, it will be judged as right-handed rotation and will count +one time (step S13). Conversely, if reflection factor level changes to 3 from 1, it will be judged as left-handed rotation and will count -one time (step S12).

[0024] [Example 3] In said example 1, although the reflection factor of the 3rd truck 9 is made to change to three phase targets, this 3rd truck 9 is realizable with various gestalten. For example, a reflection factor can change to four or more steps further gradually. When a reflection factor changes gradually, an annular pattern can be formed by vapor-depositing the reflective film. Moreover, when considering as four or more steps, a pattern can be formed so that the width of face of the hoop direction of Rhine and a tooth space, Rhine, or a tooth space may change gradually. Furthermore, it carries out like a dot, and it forms annularly, changing the surface ratio which the dot occupies.

[0025] And what is necessary is just to make actuation according to the flow chart of drawing 9 perform, in order to compare the reflected light from this truck and to perform the count of a hand of cut and an engine speed. For example, if it changes from level with the highest reflection factor to the lowest level, it will be judged as right-handed rotation and will count +one time. Conversely, if it changes from level with the lowest reflection factor to the highest level, it will be judged as left-handed rotation and will count -one time.

[0026] As mentioned above, although the example of this invention has been explained, this invention can be variously changed within limits indicated by the claim. For example, in the above-mentioned explanation, although the optical disk is using the reflective type optical disk, it can also realize this invention using the transparency type optical disk which used the slit.

[0027]

[Effect of the Invention] According to this invention, the rotary encoder which can perform energy-saving actuation which lessened energy expenditure can be obtained.

[Translation done.]